

Flexible Fiberoptic Intubation in Difficult Airway: A Retrospective Evaluation in a Portuguese University Hospital

Carolina Marramaque Miranda¹, Carlos Mexedo², Carla Cavaleiro^{2,3} and Humberto S Machado^{1,2,3*}

¹Instituto de Ciências Biomédicas Abel Salazar, Universidade do Porto, Porto, Portugal

²Serviço de Anestesiologia, Centro Hospitalar do Porto, Porto, Portugal

³Centro de Investigação Clínica em Anestesiologia, Centro Hospitalar do Porto, Porto, Portugal

*Corresponding author: Humberto S Machado, Centro Hospitalar do Porto, Largo Professor Abel Salazar, 4099-001 Porto, Portugal, Tel: +351-935848475; E-mail: hjs.machado@gmail.com

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Abstract

Objective: Fiberoptic intubation in difficult airway patients is considered gold standard practice. In 2011 our institution has created an electronic difficult airway database. The purpose of this study is to review the practice of flexible fiberoptic endoscopy at a Portuguese tertiary University Hospital, to characterize the study population and the situations in which the technique was used.

Methods: After Ethical Hospital Committee approval, a retrospective observational study was conducted to review data related to flexible fiberoptic intubation from January 2011 to June 2017. Patient's institutional Electronic Health Record was analysed to collect social and demographic characteristics, difficult airway predictability and distribution across surgical specialties, devices used in association with the flexible fiberscope, comorbidities, complications and other variables. Descriptive statistical analysis of the studied population was carried out and the ratio of fiberoptic intubation in relation to the total number of difficult airways was examined using linear regression modeling.

Results: 116 correctly-filled records of difficult airway charters were analyzed regarding patients that underwent fiberoptic intubation. The number of fiberoptic intubations has decreased over time. The most prevalent characteristics in the sample were the male gender, age over 50 years, ASA physical status greater than II and a Mallampati higher than 2 was observed in more than two-thirds of the individuals. Comorbidities such as obesity, obstructive sleep apnea syndrome, diabetes and ankylosing spondylitis were present in more than half of the patients. Most of fiberoptic intubations were performed in otorhinolaryngology procedures. The incidence of self-reported complications related to the procedure was 10.3%.

Conclusions: The major characteristics that define the patients undergoing fiberoptic intubation were identified and a correct preoperative airway examination with careful planning was highlighted. A questionnaire of "Patient Satisfaction after Flexible Fiberoptic Intubation" is proposed to understand how the practice of this technique can be improved in the future.

Keywords: Flexible fiberoptic intubation; Awake intubation; Difficult airway; Predictive factors; Assessment; Clinical alert; Patient satisfaction

Introduction

The first awake intubation was performed in 1878, by doctor Macewen, which used an endotracheal metallic tube in a patient suffering from glottic edema. More than one hundred years ago he understood, that despite the patient's discomfort, the safest technique for securing the airway was to conduct an awake intubation in patients with difficult airway [1]. This technique was not always appropriated due to anatomical or physiological limitations that interfere with the airway. As early as 1966, Shigeto Ikeda proposed the construction of the first flexible fiberscope that has occupied a central place in the management of difficult airway (DA) [2,3].

Airway assessment plays a central role in anesthesia, since the main cause of morbidity and mortality associated with anesthesia is related

to incidents in the management of the airway, which are in most cases potentially avoidable [4]. According to the American Society of Anesthesiologists (ASA) a difficult airway is considered "the clinical situation in which a conventionally trained anesthesiologist experiences difficulty with facemask ventilation of the upper airway, difficulty in tracheal intubation, or both" [5].

After a careful evaluation of medical records and physical examination, if any suspicion of a DA was diagnosed, an awake intubation (AI) was considered. In this case, intubation was achieved maintaining the airway patency, the spontaneous ventilation, the active cough reflex, protection from aspiration, and the ability to monitor the neurological status [1].

General indications for this technique include: previous history of DA, airway anatomy malformation, and patients with cervical immobilization or prevention of oral or nasal trauma. The main contraindications are patient refusal or an uncooperative patient. Relative contraindications include allergies to local anesthetics, lack of

experience, help or equipment and bleeding, fluids or foreign objects that influence a correct visualization of the airway [2,6-8].

Although the use of a flexible fiberoptic (FF) in awake intubation is considered by some authors, as the gold standard for the DA approach, this technique appears to be avoided in certain circumstances. Reasons for this fact may include: practitioners concern with anxiety or discomfort of the patient during the procedure; lack of familiarity with the use of the FF, opting by methods that they consider to be simpler; the need to anesthetize the airway to perform the procedure, requiring skill and some extra time; or insufficient time spent developing and practicing the technique [9-11].

The innovation of alternatives such as video laryngoscopy and supraglottic devices may contribute to that tendency, creating an inaccurate idea of safety [3,4,9]. Fiberoptic endoscopy maintains its superiority, since it allows the intubation of patients with severe airway variations, even though other techniques can be used in AI.

The institutional electronic information service with the collaboration of Anesthesia has created in 2011 an electronic Difficult Airway database, which consists in a clinical alert system that must be generated by the anesthesiologist in the event of a DA situation.

The purpose of this study is to use this database to review the practice of flexible fiberoptic endoscopy at a Portuguese tertiary health institution, characterizing the studied population and the situations in which the technique was used.

Methods

A retrospective observational study, by means of a systematic chart review, was conducted to review the data related to flexible fiberoptic intubation during 1st January 2011 to 30th June 2017, after Ethical Institutional Committee approval.

Data from Patient's Difficult Airway Charter (DAC), present at the electronic Difficult Airway database, was obtained of all the flexible fiberoptic intubations performed in our institution. Correctly-filled records of DAC and age above or equal to 18 years were the inclusion criteria.

Records were searched to identify: type of surgery (emergency or elective), surgical speciality, preoperative anesthetic consultation and/or preoperative anesthetic visit, predictability of DA, facemask ventilation, direct laryngoscopy and degree of Cormack-Lehane classification, intubation attempts and achievement of the orotracheal intubation, devices used in association with FF, sociodemographic characteristics (age, sex, BMI), airway characteristics (mallampati grade, thyromental distance, sternomental distance), comorbidities and risk factors (obesity, diabetes, previous history of DA), complications (hypoxia, bronchospasm, surgery postponement) and postoperative destination (ward or intensive care unit).

Parameters that could not be filled due to lack of information were coded as non-available data. Likewise, information that was not present because it would be inappropriate in that context was coded as non-applicable data.

For the statistical analysis, patient characteristics are described as percentages (n), means or medians (interquartile ranges (IIQs)). Changes in the ratio of FFI and DA over time were analysed using linear regression modeling. All statistical analysis was performed using Microsoft Office Excel 2007 (Microsoft Corporation, USA).

Results

In the analysed period, 489 records of DA were obtained, and 116 (23.7%) records of flexible fiberoptic intubations (FFIs) fulfilling the inclusion criteria were selected (four patients underwent FFI twice for different surgical procedures). Fiberoptic intubation was performed in 32% of previously identified DA.

Eighty four (72.4%) patients were males and 32 (27.6%) female, the median age observed was 59 years (interquartile range: 51-70, range: 18-86). The mean BMI (does the long form of BMI appear anywhere) was 27 kg/m² and 31 patients had BMI >30 kg/m². Majority of the patients (61.1%) had an ASA score>III. Twenty one patients (20.8%) had jaw dysmorphisms such as micrognathism, retrognathism or mandibular hypoplasia, which suggested DA. The airway characteristics and other predictors of difficult laryngoscopy are given in Table 1.

Airway characteristics	Percentage of patients (%)	Predictability of difficult airway (%)
Mallampati		
I	8% (n=8)	75.00%
II	25% (n=25)	84.00%
III	44% (n=44)	97.73%
IV	23% (n=23)	100.00%
Thyromental distance		
<6 cm	25.58% (n=22)	95.45%
≥ 6 cm	74.42% (n=64)	95.31%
Neck mobility		
<90 degrees	42.45% (n=45)	100.00%
≥ 90 degrees	57.55% (n=61)	93.44%
Mouth opening		
<4 cm	38.67% (n=41)	100.00%
≥ 4 cm	61.32% (n=65)	90.77%

Table 1: Analysis of airway characteristics.

There were variations in the proportion with which FFI was performed in relation to the total number of difficult airways examined. Figure 1 outlines the ratio details in six-month time intervals. This resulted in a linear regression function of $y = -0.0271x + 0.4519$, where x represents the proportion of FFI in relation to the total number of difficult airways.

In the 116 Difficult Airway Charter analysed, ventilation with a facemask was not applied in 69 (59%) patients (awake intubation subject). In those in which the facemask was applied, 14% were difficult to ventilate while 12% were easily ventilated.

There were 54 patients (47%) in whom direct laryngoscopy was considered difficult, the majority of which corresponded to a grade 3 (n=34) in the Cormack-Lehane classification. Regarding direct laryngoscopy recorded as not difficult (5%), all patients belonged to

grade 1 (n=4) or grade 2 (n=2). Finally, in 44 (38%) individuals direct laryngoscopy was not tested.

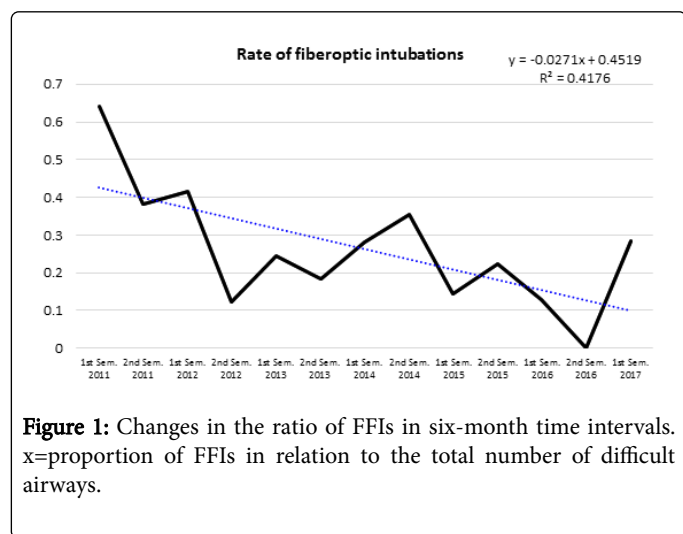


Figure 1: Changes in the ratio of FFIs in six-month time intervals. x=proportion of FFIs in relation to the total number of difficult airways.

Flexible fiberoptic intubations were performed as an isolated technique in 95 (82%) cases. In the remaining cases (18%), other strategies were also used for the management of the airway, the most common association being the use of FF with video laryngoscopy Figure 2.

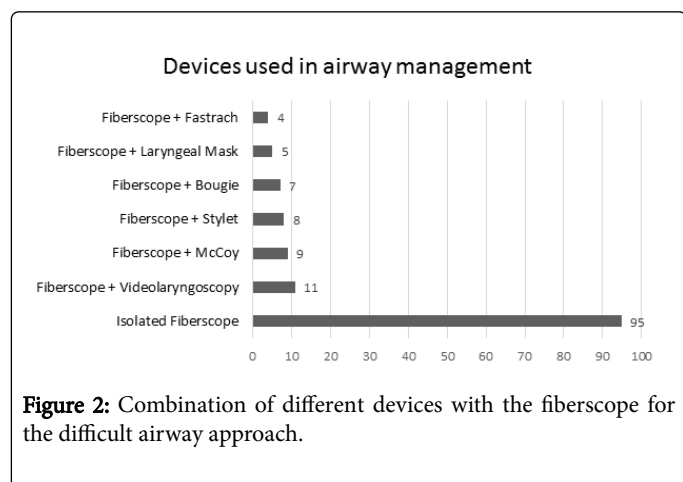


Figure 2: Combination of different devices with the fiberoptic for the difficult airway approach.

According to the DAC, 94.1% (n=101) of the patients that underwent elective surgeries had an anticipated difficult airway, but if only emergent surgeries are considered, 86.7% (n=15) of subjects had anticipated DA. Of the 101 scheduled surgeries, 69.3% of the patients had a preoperative evaluation: 28.6% at preoperative consultation, 54.3% at preoperative visit, and 17.1% in both. These evaluations were performed at different times by different anesthesiologists, that agreed on the anticipated or the unanticipated difficulty of the airway intubation in 92% of the cases.

To obtain a better understanding of the distribution of the patients who underwent FFI in each CHP department, the following graphic was elaborated Figure 3. The otorhinolaryngology (ENT) department was the one with the highest number of FFIs (n=30), followed by General Surgery (n=29) and Maxillofacial Surgery (n=19). In the ENT department, most of the surgeries that used FFI were in the neck

region, while in the General Surgery department most of the surgeries were in the abdomen and pelvis.

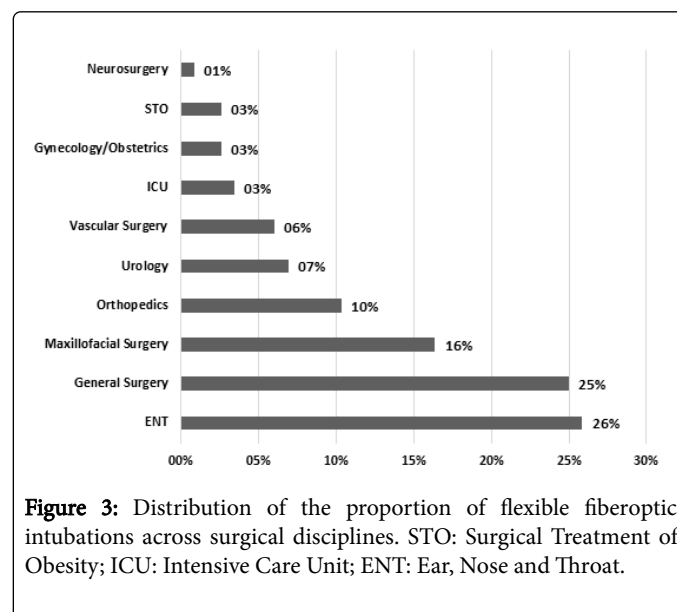


Figure 3: Distribution of the proportion of flexible fiberoptic intubations across surgical disciplines. STO: Surgical Treatment of Obesity; ICU: Intensive Care Unit; ENT: Ear, Nose and Throat.

The presence of comorbidities associated with DA were recorded, being obesity (BMI>30 Kg/m²) the most frequent one (n=31), followed by obstructive sleep apnea syndrome (OSAS) (n=29) and diabetes (n=27). There were also 7 patients with ankylosing spondylitis. On the other hand 43.1% (n=50) didn't had any of the referred comorbidities.

Observing the most frequent risk factors correlated with DA, 20% of the patients had head and neck diseases and another 20% had intrinsic airway neoplasms. In some cases, there was also a previous history of DA (19%) and spinal deviations (15%) (Figure 4).

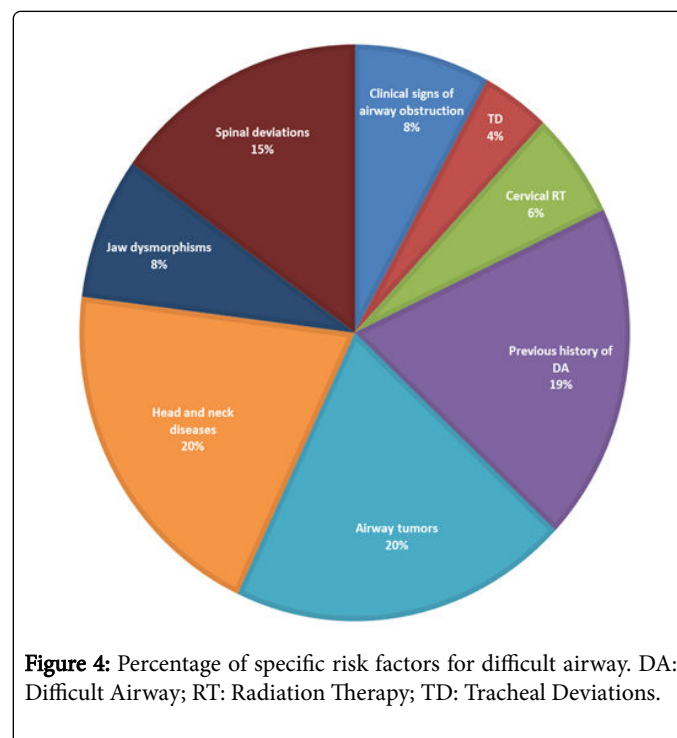


Figure 4: Percentage of specific risk factors for difficult airway. DA: Difficult Airway; RT: Radiation Therapy; TD: Tracheal Deviations.

Complications associated with FFI occurred in 12 (10.3%) patients. In this group, 9 patients were identified as having predictable DA and one patient had no information on this parameter. Patients were male in 66.7% of the cases, had a mean age of 66 years and 8 patients had a physical status score, equal to or greater than ASA III. Five patients required post-operative Intensive Care. The most frequent complication was more than 3 attempts of FFI (n=7), followed by transient hypoxia (n=5) and surgery postponement (n=2).

A failed orotracheal intubation (OTI) was reported, which indicates a FFI failure rate of 0.86%. This case corresponded to an elective total thyroidectomy, with a preoperative visit where the DA was anticipated. Intubation was attempted several times, failing due to severe distortion of the upper airway and impossibility to continue with the fiberoptic and orotracheal tube. This patient presented four complications, including more than 3 attempts of intubation, edema of the glottis and bronchospasm, which culminated in postponement of the surgery.

Discussion

In our study investigators observed a slight decrease in the ratio of FFI performed, which is in accordance with published data and possibly related to the rise in popularity of new alternatives, such as video laryngoscopy and third generation supraglottic devices [3,9,12-14].

However, this interpretation may not be completely feasible, since after the second half of 2016, in which no FFIs were performed, there is a major increase in its execution rate in the following semester. Therefore, it would be useful to observe a longer period of time. It should also be taken into account, that the graphic in question used the total number of DAC found, which means that the variations observed may not be due to the change in the rate of FFIs performed, but rather to the reduction in the number of correctly-filled charts. In addition, there are also logistic limitations related to the lack of resources that can explain the reduced use of fiberoptic endoscopy, such as, the small number of flexible fiberoptic scopes that exist in the hospital and being a more technically demanding procedure.

In our medical centre FFI is done, foremost, with a consent patient, which can be seen by the 69 patients (59%) in whom the facemask ventilation (FMV) was not tested. Nevertheless, the practices are different among the several anesthesiologists of the service (87 attending physicians and 40 residents), and FFI can also be done after general anesthesia, which was the case in 26% of the patients.

Examination of the glottis is of extreme importance in predicting a difficult intubation. Thus, in situations where the vocal cords aren't visualized with direct laryngoscopy, corresponding to a grade 3 or 4 in the Cormack-Lehane classification, the direct laryngoscopy is considered difficult, which makes intubation success less likely [15,16]. Direct laryngoscopy after FFI allows risk stratification for future airway approaches; nevertheless, a large proportion of patients (38%) in our study weren't tested. As for difficult direct laryngoscopy, practically all patients belonged to grade 3 or 4, which is in agreement with the definition of the same.

Several studies have demonstrated the advantage of using FF in DA situations [3,17]. Having a sample of patients with DA who underwent FFI, it's expected that, in most cases (64%) the technique was used alone. On the other hand, the combination of different devices leads to higher success rate and morbidity reduction, while promoting an expansion of clinical knowledge [18]. Thus, in our study there were 39

cases (36%) where the flexible fiberoptic was used in combination or after failed intubation attempts with other devices.

According to American Society of Anesthesiologists (ASA) members and consultants "airway history should be conducted, whenever feasible, before the initiation of anesthetic care and airway management in all patients" [5]. As stated by Baker in 2015, preoperative anticipation of difficult airway only occurs in 50% of the patients [19,20]. In this study, more than half of DA patients were evaluated in the preoperative period (69.3%), and the airway was correctly identified as difficult in 87.1% of the cases. However, there are still a great proportion of patients with unpredictable DA, possibly due to considerable variability between interpersonal airway evaluations, insufficient airway assessment or use of subjective parameters.

The departments that performed a greater number of FFIs for DA situations were ENT (25.9%) and General Surgery (25.0%), which also was the case in the Heidegger et al. [14] study likewise, Maxillofacial Surgery (16.4%) was responsible for a large proportion of FFIs performed. Regarding ENT and Maxillofacial Surgery this number would be expected, since the surgical anatomical regions often overlap the airway. Since 83.7% of these patients had head and neck diseases, such as airway tumors and jaw dysmorphisms, making intubation with devices other than the FF difficult or even impossible, these facts might explain these results. Concerning General Surgery, most surgeries involved the abdomen and/or the pelvic region (58.6%), but these patients had airway-specific risk factors, comorbidities and other unfavourable characteristics that made intubation less likely to be successful, thereby FFI was chosen.

Obesity, OSAS, diabetes and ankylosing spondylitis are predictive factors of greater difficulty in FMV and orotracheal intubation; therefore, it's not surprising that a high number of patients (56.9%) had at least one of these comorbidities. Besides, patients with more than one disease have a synergistic effect related to an increased risk of DA.

In our institution, the incidence of complications associated with FFIs was 10.3%. In articles related to awake intubation of anticipated DA, complication rates of 1.6% were reported by Thomas et al. [9] and 15.7% by Law et al. [10]. However, the reported complications in those studies were not the same as those considered in our investigation. Regarding our sample, all described complications had no long-term consequences for the patient.

The fact that transient hypoxia is one of the most frequently reported complications may be related to the type of anesthesia associated with FFI, which in these cases consists only of sedation and/or local anesthesia. Since the patient is awake during the procedure, inappropriate anesthesia may lead to transient hypoxia, either because suboptimal levels of sedation can cause the patient to react to airway instrumentation, or because the excess of patient sedation may lead to a decrease in airway patency.

Regarding failed orotracheal intubation, there was only one case reported, in which multiple attempts at intubation led to glottic edema, bronchospasm and postponement of surgery. The reported 0.86% FFI failure rate in our study was similar to the 1% rate obtained by Thomas et al., in a study where causes of failure were related to the impossibility of passing the endotracheal tube through the vocal cords (n=8) or complete inability to visualize the larynx (n=2) [9]. In another investigation, by Heidegger et al. a 1.8% failure for awake nasotracheal intubation was reported, which was identical to the 1.2% failure rate described by Ovassapian et al. [14,21].

In order to reduce complications and failed intubations and, consequently, the morbidity and mortality associated with airway management, it's extremely important to correctly evaluate the patient and to delineate a preoperative plan [5]. Additionally, spending time practicing FFI is essential, since most causes of failure in the operating room are due to clinician inexperience [8]. Therefore, the 1998 National Confidential Enquiry into Perioperative Deaths and the 2011 NAP4 reports have recommended that awake intubation with flexible fiberscope should be a core skill for anesthetists [3].

At the end of this investigation, the creation of a questionnaire for patients who underwent FFI was proposed, in order to assess their degree of satisfaction with the procedure. This questionnaire also aims to understand the quality of the information transmitted to patients about the technique, and their perception of the need to perform it. In addition, it assesses the anxiety experienced before FFI, their comfort during the procedure, if there were complications associated and the willingness to repeat the FFI if needed. All these factors are important in understanding how patients and health care workers co-operate during FFI. The purpose is to create a tool that helps anesthesiologists improve the technique and adapt it to each patient. It's also expected that a more adequate knowledge about the patient's perception of FFI will reduce the discomfort that certain physicians feel during the execution of the technique. Thus, in future, there would be a greater use of the flexible fiberscope in clinical practice and an increase in the success and safety of the intubations.

In this study, data collection was affected by many factors, such as changes in the computer electronic system that occurred during the analysed period and changes in electronic anesthetic sheets that meant that information was not always correctly entered into the system.

According to Soares, in a master thesis based on the same database for the years of 2011-2012, the rate of completed DAC was only 39%. If this trend persisted in the following years, the total number of DA situations in this study, and possibly also the number of FFIs, are underrated.

Conclusions

In our study, flexible fiberoptic intubation was performed in 32% of previously identified DA. A significant difference between the percentages of predicted difficult airways that occurred in elective surgeries compared to emergent surgeries was identified. In accordance to the publish literature, we observed a decrease in the ratio of FFIs performed, which can be related to the increasing popularity of alternative devices.

The most prevalent characteristics in the sample were the male sex, age over 50 years and ASA physical status greater than II. In addition, a Mallampati higher than 2 was observed in more than two-thirds of the sample. Comorbidities such as obesity, OSAS, diabetes and ankylosing spondylitis were present in more than half of the patients. Furthermore, the presence of head and neck diseases, airway tumors and previous records of DA is not negligible. In almost half of the patient's direct laryngoscopy performed after FFI was considered difficult, of which the majority were a grade 3 in the Cormack-Lehane classification.

Investigators found that most of FFIs were performed in ENT surgeries. Our institution is a tertiary care hospital, where most surgeries are represented, therefore we have no reason to believe that our sample of patients differs significantly from other institutions.

Nevertheless, certain practices or procedures may differ since this centre has the quality of a teaching-hospital, accredited by the European Society of Anaesthesiologists.

The most frequently reported complications were the need for more than 3 attempts of intubation and transient hypoxia. There was one case of failed orotracheal intubation, were multiple attempts at intubation led to glottic edema, bronchospasm and postponement of surgery. On account of this being a retrospective study, the accuracy of the data can't be fully ensured, especially in self-reported complications.

In this article, it was highlighted the necessity of a correct preoperative airway examination and careful planning of its approach, having a positive impact in the morbimortality associated with the airway in the anesthetic act. Equally important, is the correct registration of the Difficult Airway Charter whenever the anesthetist is faced with a DA situation since the alert created will lead to greater safety in subsequent anesthetic procedures. Finally, the investigators proposed the creation of a questionnaire for patients who underwent FFI, in order to improve the practice of this technique in the future.

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